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ABSTRACT

The document is a guide to a 9th and 10th grade industrial education course investigating the total system of power--how man controls, converts, transmits, and uses energy; the rationale is that if one is to learn of the total system of industry, the subsystem of power must be investigated. The guide provides a "body of knowledge" chart delineating the content possibilities for any power-related course at any level of instruction, orientation suggestions, safety instruction, and introductory activities such as suggested teacher demonstrations and discussions of career possibilities. Lesson plans covering five major topics comprise the bulk of the guide; objectives, equipment, resources, and the procedure for learning activities are provided for: (1) power conversion (26 days); (2) mechanical transmission (5 days); (3) fluid transmission (8 days); (4) electrical transmission (8 days); (5) synthesis of power systems (a single "synthesis problem" occupies the students for 14 days). Appended are a definition of behavioral objectives; a pretest, posttest, and attitude inventory, with answer sheets; an equipment list; and a bibliography. The guide is one of the outcomes of the Secondary Exploration of Technology (SET) Project. (AJ)

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Secondary Exploration of Technology

Power Conversion and Transmission Systems

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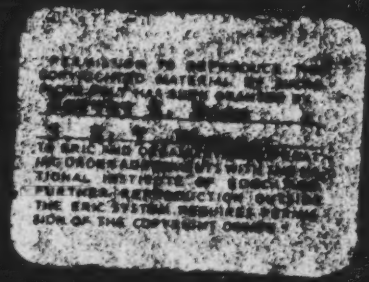

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Cooperative Research - USD 446, 244, & 512 with Kansas State College of Pittsburg & Title III of The State Department of Education, Topeka

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Secondary Exploration of Technology

Dear Colleague:

We are happy to forward the Power Conversion Transmission System document to you. We feel that implementation of a curriculum designed around the concepts represented in this document will provide students with relevant understanding of power systems.

In order to implement the curriculum contained in this document, you will need to purchase the equipment listed on page 88. You will also need to purchase Worthington's book, GENERAL POWER MECHANICS, D.C.A.'s Transparencies "Power Technology", and other reference material pertinent to the equipment required for the course.

We do not maintain that this document represents the answer for a course in Power. However, the document has proven successful in the project schools. We solicit your suggestions for curriculum revision and your comments pertinent to the curriculum.

Sincerely,

Harvey Dean

Harvey Dean
Director

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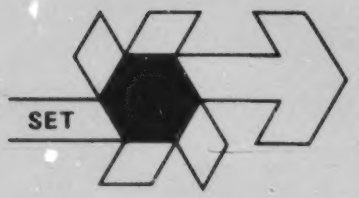

THE SECONDARY EXPLORATION OF TECHNOLOGY PROJECT

S. E. T. PROJECT
Position Paper

on the
Rationale for the Study of the Total Systems of
Materials Analysis and Processing Systems, Power, Industrial Communications Systems
within Industrial Education Classes

The basic idea of the American economic system is to provide services to people or to produce a saleable product for a profit. Industry is that portion of the economic system that provides material goods by changing raw materials into products that have greater value than the raw material. Industrial service industries are concerned with keeping such products usable.

Broad based programs such as IACP Construction and Manufacturing provide students an opportunity to investigate the concepts of the total system of industry through meaningful activities. If one is to further investigate the principles of the total system of industry at or beyond the concept level, it becomes necessary to divide the principles into meaningful sub-systems.

The sub-systems of industry are: (A) Governmental Policy (B) Business Management (C) Personnel (D) Material Analysis & Processing Systems (E) Energy Systems (F) Industrial Communications Systems.

The sub-system of Governmental Policy includes the areas of the federal monetary system, natural and/or developed resources, "rules of the game" in which private industry must operate, etc.

Business Management includes the areas of operating our industries. Management topics may be marketing, management, finance, etc.

The sub-system of Personnel includes the "people problems" of industries. Personnel areas may be health, recreation, training, retiring, education, etc.

At this point in time, the Industrial Education Field must assume that the content of the three subsystems described above are taught within other curricular areas in the schools.

The content of the three remaining sub-systems of industry should then be the responsibility of the industrial education curriculum.

The S.E.T. Project systems course in Material Analysis & Processing Systems allows students to experience the methods of processing (changing) raw materials of all kinds into saleable products. It also allows students to experiment with the similarities and differences between raw materials and processing methods.

Power evolved as the need for new material processing methods developed. The developments of power technology are available to everyone in today's society. The developments have raised America's standard of living. The system course in Power provides the student with an understanding of how man has taken the basic forms of energy and systematically converted and transmitted them to work for him. The course also allows students to investigate the function of the prime movers in our transportation systems.

Communication has been, and still is, man's link to man and machine, and machine's link to man and other machines. In industry, communication allows one man's idea to become a reality as a saleable product. The systems course of Industrial Communications provides students with an understanding of how man can develop ideas and communicate them to other people and machines. The course includes various types of communication systems utilized in industrial settings.

Industry is a total system which includes man's changing of materials for man; utilizing the power developed by man; while communicating with all men.

It is impossible to teach the total system of Industry by selecting one element of the sub-system and developing it into a single course. However, after learners conceptualize industry and experience the system, it becomes realistic and psychologically feasible to begin studying the individual elements in individual courses.

S.E.T. Project Teachers and Staff
June, 1973

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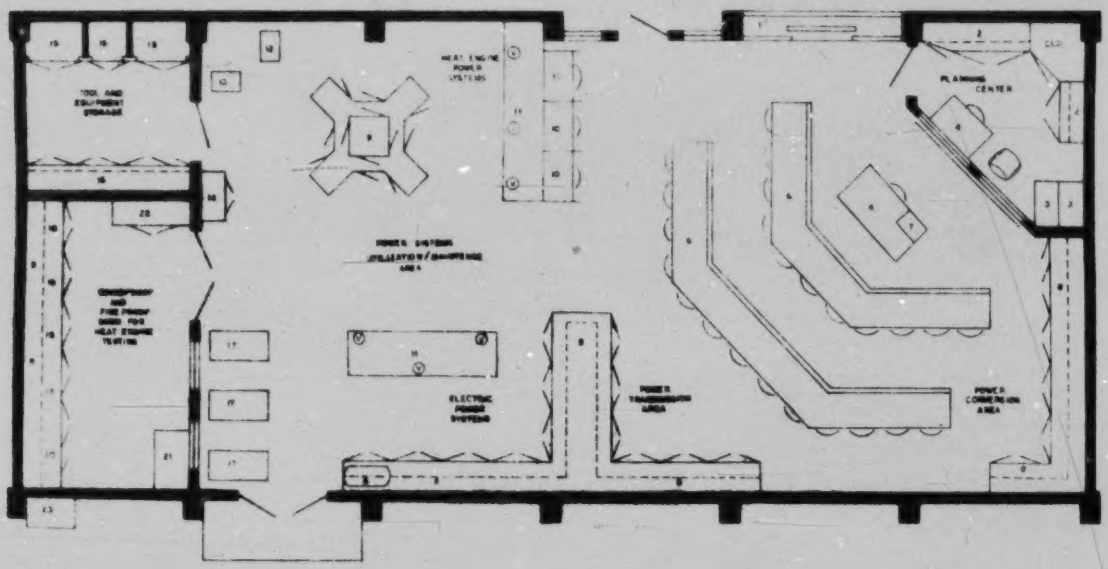
EXEMPLARY POWER CONVERSION AND UTILIZATION LABORATORY 32 X 72 FT.



1. display cabinet
2. storage cabinet/bookcase
3. file cabinet
4. teacher desk
5. sliding blackboard and projection screen
6. student seating (with electrical power strip at front)
7. overhead projector
8. storage over/under cabinet (electric and air outlet on counter)
9. small engine analysis center (with small engines: diesel, z-cycle and c cycle gas)
10. study carrels
11. work table (storage under)
12. arbor press
13. drill press
14. grinder/buffer and cabinet
15. storage closets
16. tool storage
17. auto engine w/stand
18. small eng. dyno. built in
19. environmental test unit
20. compressor vise-cabinet
21. auto engine dyno equipment
22. stem engine demo stand
23. exhaust and fume removal and muffler system

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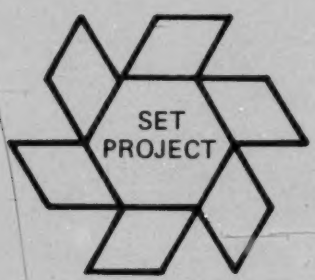
POWER CONVERSION AND TRANSMISSION SYSTEMS

A 9th and/or 10th grade Industrial Education Curriculum fulfilling of the Kansas State Department of Vocational Education's level two course requirements.

••••EDITED BY HARVEY DEAN, PROJECT DIRECTOR••••



DEVELOPMENTS OF THE

1972 AND 1973 SUMMER WORKSHOPS

OF THE

SECONDARY EXPLORATION OF TECHNOLOGY

ESEA TITLE III PROJECT

26-70-1003

STATE OF KANSAS

IF YOU SHOULD HAVE QUESTIONS, COMMENTS OR REQUESTS PERTAINING TO THIS GUIDE, PLEASE CONTACT:

DIRECTOR, S.E.T. PROJECT
KANSAS STATE COLLEGE
PITTSBURG, KANSAS 66762

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PREFACE

The Secondary Exploration Technology document, **Power, Conversion, Transmission,** and **Utilization,** represents a cooperative effort between the Kansas School districts of Independence, Burlington, Shawnee Mission, and KSCP. It further represents a summer of initial trial development by ten (10) S.E.T. teachers with guidance from the S.E.T. Project Staff, a year of trial implementation in the three school districts and a final summer of revision and synthesis by project teachers and staff.

The S.E.T. Project Curriculum seeks to provide the teacher with the objectives, equipment, material, supplies, references, and activities necessary to teach students the System of Power--from energy source, through conversion, to transmission and finally to utilization. Career information and the sociological implications of Power is also included in activity form.

The user of this guide should recognize that activities to encompass the entire body of knowledge as depicted on page 2 are not included. It is impossible to teach in one semester, one year, or in one program the intracacies of the total body of knowledge. It is possible to teach the concepts of how each system of power interrelates to the other systems of power. Therefore, the S.E.T. Power document provides a guide for the teacher to teach the System of Power.

The credit for the content in this guide goes to the S.E.T. Teachers who developed, tried, revised and synthesized this curriculum. The curriculum should prove successful in other schools because of the practical and realistic activities delineated by the teachers.

The Teachers chose the equipment as listed in order that Students could successfully complete given activities and meet specified objectives.

Other similar equipment may be available to complete given activities. It is not the purpose of this document to endorse educational equipment but merely to note equipment which proved successful in meeting the listed objectives for specific activities.

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ACKNOWLEDGEMENTS

The following men deserve special credit for their work in leading the sessions in which this Curriculum Guide was developed and synthesized:

Chairmen of 1972 Summer Trial Guide development

Carl Rolf
Shawnee Mission Northwest High School
Shawnee Mission, Kansas

Richard Laubhan
Trailridge Jr. High
Shawnee Mission, Kansas

Coordinator Synthesizing document during
1973 Summer Workshop at KSCP

Richard Laubhan
Trailridge Jr. High

Teachers who helped in the development of the Trial Guide, who taught from the trial guide and who helped during the synthesis of the guide:

Nick Thielan
Shawnee Mission Northwest High School
Shawnee Mission, Kansas

Ron Thuma
Burlington High School
Burlington, Kansas

Charles Daneke
Independence High School
Independence, Kansas

Vernon Pauls
Indian Hills Jr. High
Shawnee Mission, Kansas

Appreciation is also extended to project consultants Dr. Don Manual, Dr. Don Amelon, Morris Tischler, Dr. Richard Weathers, and company representatives who gave their time and efforts to demonstrate equipment to the project developers.

Harvey Dean, Director
F.V. Sullivan, Project Consultant

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RATIONALE FOR POWER

Throughout history man has used and developed nature's energy into power systems that help him fulfill his needs---from the simple fires of cavemen to the complex machines of today's industry.

Power performs the work of industry. As an outgrowth of the development of power, our standard of living has improved positively. If one is to learn of the total system of industry the sub-system of power must be investigated.

The study of power is the investigation of how man controls, converts, transmits, and uses energy.

The S.E.T. Project's body of knowledge (see page 2) delineates the content possibilities for any Power or power related course at any level of instruction.

The level I course recommendation contained in this document attempts to investigate the total system of power. Power courses beyond level I should include in-depth study of components from the Body of Knowledge.

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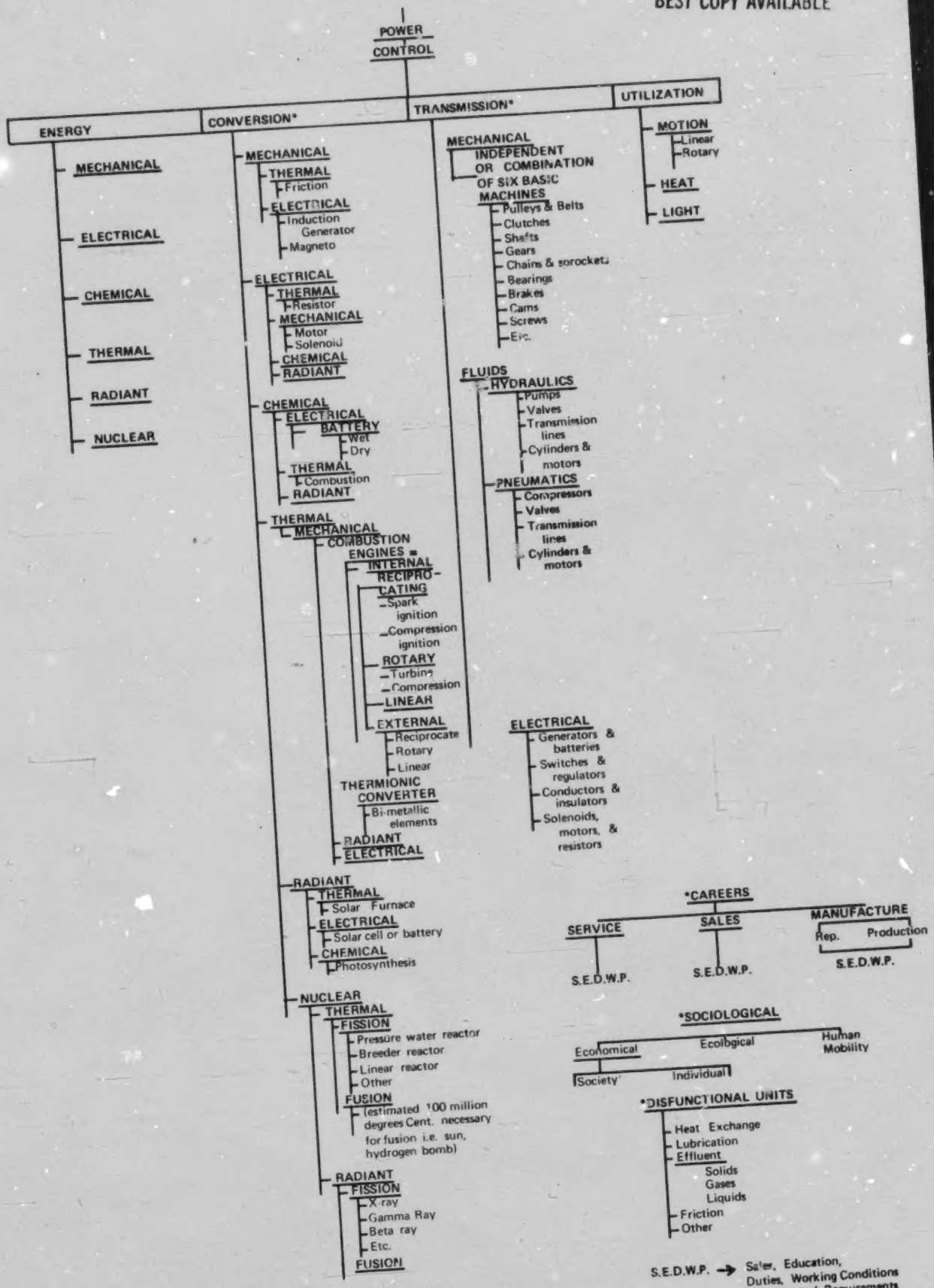

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GOALS OF POWER

1. To develop an understanding of the concepts and principles of energy conversion, power sources, power transmission and power uses.

2. To provide a knowledge and understanding of how power sources, transmission and uses are combined to produce power systems.

3. To provide experiences with power components by constructing, servicing, and developing power circuits and systems.

4. To develop an insight into the various career opportunities available in the field of power.

5. To develop knowledge and experience in the relationship of power to other disciplines; to all curricular areas; and industrial applications.

6. To develop positive safety attitudes and practices pertaining to work and the study of power.

7. To provide an insight into the socio-economical and/or environmental effects of power.

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S.E.T. Project Power Curriculum

PERFORMANCE OBJECTIVES

The performance objectives listed below should provide realistic attainment levels for students enrolled in the power course described in this guide. Each teacher may wish to establish his own performance levels for the course rather than use those indicated below. However, the Test instruments included in Appendix D should prove valuable regardless of teacher choice.

Performance levels are not established for the activities delineated in this guide. Each teacher using this guide is encouraged to establish performance levels for his own class per activity and to build in his own evaluation criteria.

Definitions of Performance Objectives in the Psychomotor, Affective, and Cognitive domains are included in Appendix A.

Cognitive Performance Objective

Upon exiting the S.E.T. Project power course the students will indicate a knowledge of Power, Conversion, Transmission, and Utilization as evidenced by an increase of 20% in Mean score between pre- and post-testing on the S.E.T. Project Power Curriculum Tests.

Affective Performance Objective

Upon exiting the S.E.T. project Power course the students will indicate the value of the study of power as evidenced by a 15% increase in the mean score between the S.E.T. project pre-Power Curriculum attitude inventory and the post-Power Curriculum attitude inventory.

Psychomotor Performance Objective

During the Power course the student will perform psychomotor skills in at least the imitation and/or manipulative level as evidenced by the teachers records of successful completion of at least eight of ten teacher selected activities that suggest these levels of skill development.*

***Refer to Appendix A.**

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BROAD ACTIVITY OBJECTIVES FOR STUDENTS ENROLLED IN POWER

1. The student will investigate, research, and/or conduct experiments with the sources of energy as evidenced by the completion of the prescribed activities in the unit of study.

2. The student will investigate, research, conduct experiments and/or activities in the conversion of energy from one form to another as evidenced by completion of the prescribed activities in the unit of study.

3. The student will investigate, research, conduct experiments and/or activities in the transmission of Power from one point to another as evidenced by completion of the prescribed activities in the unit of study.

4. The student will investigate, research, conduct experiments and/or activities in the utilization of power as evidenced by completion of the prescribed activities in the unit of study.

5. The student will investigate, research, conduct experiments and/or activities in career orientation related activities and other aspects of power as evidenced by completion of the prescribed activities in the unit of study.

6. The student will research, investigate, conduct experiments and/or activities involved in designing, construction, use and/or operation of a selected power system as evidenced by the completion of the selected activities within the designated unit of time.

7. The student will demonstrate his knowledge of the controls of power and energy as evidenced by participation in the prescribed activities in the unit of study.

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CONTENT OUTLINE

FOR POWER AND ENERGY

Suggested for Level II Courses

The sequence presented in content outline is imperative

for the success of the Systems/Conceptual Approach.

One Semester (days)	Topic or Area of Instruction
4	I. ORIENTATION A. Shop Procedures B. Pretest C. Safety
2	II. UTILIZATION AND APPLICATION OF POWER TO DO WORK A. General Discussion B. Power Systems in Operation C. General Career Orientation D. Sociological Impact of Power Systems
2	III. BASIC ORIENTATION OF POWER TRANSMISSION TO UTILIZATION A. Teacher demonstration of simple: 1. Hydraulic systems 2. Electrical systems 3. Mechanical systems 4. etc.
1	IV WHAT IS POWER AND ENERGY? A. Sources & Forms of Energy 1. How converted 2. How transmitted B. The System and Control of power
46	V. CONVERSION & TRANSMISSION A. Power Conversion B. Mechanical Transmission C. Fluid Transmission D. Electrical Transmission
14	VI. SYNTHESIS OF POWER SYSTEMS A. Suggested Activity
14	VII. INDEPENDENT STUDY A. Suggested activity
2	VIII. CONCLUSION
5	IX. Days generally lost due to normal school interruptions
90	TOTAL

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GUIDELINES FOR THE USE OF THE ENCLOSED ACTIVITIES

The following pages include suggested activities that provide the student with an awareness of the total system of power. The activities relate to the cognitive, affective and psychomotor domains of behavior.

Several methods may be used to teach the activities dealing with conversion and transmission (Section V). One method is to allow the entire class to do the activities at the same time. Another method is to divide the class into 4 or 5 groups and rotate the groups through the different activities. The teacher should select the method which best meets his local situation.

We encourage teachers using this document to expand and revise individual activities to fit their own situation. If activities need to be omitted because of time, omit activities from each set, not an entire set of activities.

Teachers should continually relate individual activities to the total body of knowledge. If this relationship is lost, understanding of the total system of power is lost.

TEACHER: You must prepare for each lesson prior to teaching the lesson. The S.E.T. Project staff recommends that you read this entire document before beginning your course.

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* SECTION I. ORIENTATION

A. SHOP PROCEDURES (DAY1)
B. PRE TESTS (DAY 2)
C. SAFETY (DAYS 3 & 4)

DAY 1: The teacher should discuss with the class the normal beginning of class procedures. This may include the assignment of seats, collecting of fees, assignment of lockers, etc.

DAY 2: Administer the pretest and the attitude inventory. (Pretest and attitude inventories in Appendix D). Evaluate each to determine what the students know and how they feel about power.

DAYS 3 and 4: The teacher should present, demonstrate, and discuss the safety information contained on the next page. An evaluation of the student's knowledge of safety may be conducted following the presentation by the teacher.

* Refer to content outline, p. 6.

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Safety Instruction

Teachers using this document should present safety instructions and evaluate student performance on safety in the following areas:

A. General

1. Shop procedures
2. Fire prevention and drills
3. Severe weather precautions
4. Safety clothing and dress
5. Eye protection
6. Handling and use of basic hand tools
7. Reporting and care of minor injuries

Specific safety instruction and student performance evaluation should be administered in the following areas:

A. Electrical Devices

1. Safety fuses, switches
2. All wires properly insulated
3. Loose connections
4. Properly grounded
5. Proper identification of parts and components
6. Proper handling of dangerous voltage and current

B. Heat Engines

1. Refueling of engines
2. Proper ventilation and exhausting of poisonous fumes
3. Rotating shafts and hot parts of engines

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C. Mechanical Devices

   I. Exposed belts, pulleys, and gears

D. Fluidic Devices

   I. Compressed air and fluids

Each teacher of power should make an effort to redesign, rearrange, and equip their own shops so as to provide an environment as safe as possible--one where injuries would be an accident.

The following book is an excellent source for shop safety and safety instruction:

Accident Prevention Manuel for Shop Teachers, American Technical Society, Chicago, Illinois.

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* SECTION II. UTILIZATION AND APPLICATION OF POWER TO DO WORK

A. GENERAL DISCUSSION (DAY 1)
B. POWER SYSTEMS IN OPERATION (DAY 1)
C. CAREER ORIENTATION (DAY 2)
D. SOCIOLOGICAL IMPACT OF POWER SYSTEMS (DAY 2)

During the next 2 days the teacher should discuss with the class how power does work for man. The career possibilities and the sociological impact of power on society should be emphasized wherever appropriate.

DAY 1: 1. Demonstrate several power systems doing work.

Examples: Air compressor, drill press, grinder, small engine, etc.

2. Discuss how the demonstrated power systems do work for man.

DAY 2: 1 Discuss with the class six different careers that are associated with the operation, construction, designing and maintenance of the power systems that were demonstrated yesterday.

2. Select several items that have been printed in the news media recently pertaining to energy conservation, pollution, etc. Discuss these articles with the class.

* Refer to content outline, p. 6.

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* SECTION III. BASIC ORIENTATION OF POWER TRANSMISSION TO UTILIZATION

A. TEACHER DEMONSTRATIONS OF THE TRANSMISSION SYSTEMS (2 DAYS)

During the next two days the teacher should show how power is transmitted and controlled from the point of conversion to the point of utilization.

DAY 1:
1. Demonstrate to the class a simple electrical transmission circuit.

   Example: Connect a bulb to a battery using a switch as a control device.
2. Discuss how electrical energy can be transmitted from one point to another.
3. Discuss the control mechanisms of electrical transmission (switches, relays, etc).
4. Discuss several careers associated with the transmission of electrical power.
5. Discuss the sociological impact of power transmission by electrical means.

DAY 2:
1. Demonstrate to the class a simple fluidic transmission system and a simple mechanical transmission system.

   Example: Connect an air motor or cylinder to an air compressor with an on-off valve.

   Example: Use a simple lever or belt-pulley system such as on a variable-speed machine.
2. Discuss how energy can be transmitted by fluid and mechanical means.
3. Discuss the control mechanisms of fluid and mechanical transmission systems.
4. Discuss several careers associated with fluid and mechanical transmission.
5. Discuss the sociological impact of fluid and mechanical transmission systems.

* Refer to content outline, p. 6.

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* SECTION IV. WHAT IS POWER AND ENERGY
A. SOURCES AND FORMS OF ENERGY
B. THE SYSTEM AND CONTROLS OF POWER (1 DAY)

The total system of power should be discussed today.

1. Discuss how energy can be converted, transmitted, and used to do work for man. (Refer to Body of Knowledge, p. 2)
2. Define and discuss the six basic forms of energy and give examples of each. (Refer to Body of Knowledge, p. 2)
3. During discussion make sure students understand the total system of Power--Energy--Conversion--Transmission--Utilization--and the controls used throughout each of the steps.

* Refer to Content Outline, p. 6.

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SECTION V

POWER CONVERSIONS

26 Days of Activities

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SECTION V. Power Conversion

ACTIVITY
"Converting Mechanical to Thermal or to Electrical Energy"

Allow 1 class period

OBJECTIVE: At the conclusion of this activity the student will understand the concept of mechanical to thermal and to electrical conversion by participating in the discussion as evidenced by the teachers records.

EQUIPMENT AND SUPPLIES NEEDED: None

REFERENCE MATERIAL: GENERAL POWER MECHANICS by Worthingtor., Units 25 & 51

PROCEDURE FOR THE ACTIVITY

1. Discussion/Demonstration
   I. Discuss forms of friction
      a. Useful friction
      b. Harmful friction

   2. Demonstrate friction by rubbing 2 objects together.

   3. Discuss the basic generator
      1. Explain principle involved
      2. Sketch on the board and show how a simple generator can work.

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SECTION V. Power Conversion

ACTIVITY
"Converting Mechanical to Electrical Energy"

Allow 4 class periods

OBJECTIVE: At the completion of the activities the student will understand the concept of mechanical to electrical conversion as evidenced by successful completion of the prescribed activities.

EQUIPMENT AND SUPPLIES NEEDED: Electronic Aids I000, Electronic Aids SI000CK, McKnight & McKnight Power Experimenter Unit

REFERENCE MATERIAL: MECHANICAL CONTROL MANUAL McKnight & McKnight Publishing Company
SI000CK INSTRUCTION MANUAL. Electronic Aids
CONCEPTS OF ELECTRICITY, Electronic Aids
ELECTRICAL CONTROL MANUAL, McKnight & McKnight Publishing Company

PROCEDURE FOR THE ACTIVITY

1. STUDENT ACTIVITY--Complete the following activities

Day 1: McKnight Power Experimenter Experiment #52: changing motion into electricity.
MECHANICAL CONTROL MANUAL pages 52-26 to 52-30.

Day 2: SI000CK Experiment #33: Moving a magnet within a coil produces electricity.
SI000CK INSTRUCTION MANUAL pages I8I-I83.
Option: The following activity is essentially the same and could be substituted for above: EAI000 Experiment #4: Magnetism produces electricity.
CONCEPTS of ELECTRICITY pages I6-I8.

Day 3: EAI000 Experiment #6: Mechanical motion in a magnetic field produces electricity.
CONCEPTS of ELECTRICITY pages 23-25.

Day 4: McKnight Power Experimenter Experiment #E7: Producing a continous supply of electricity with a generator.
ELECTRICAL CONTROL MANUAL pages E7-205 to E7-2I0.

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SECTION V. Power Conversion

ACTIVITY
"Converting Electrical to Mechanical, to Thermal, to Radiant and to Chemical Energy"

Allow 5 class periods

OBJECTIVE: At the completion of the activities the student will understand the concepts of Electrical to Mechanical, to Thermal, to Radiant, and to Chemical conversions as evidenced by successful completion of prescribed activities.

EQUIPMENT AND SUPPLIES NEEDED: Electronic Aids 1000 and SI000CK Trainers, cheese, vegetables, fruits and meats.

REFERENCE MATERIAL: CONCEPTS of ELECTRICITY, Electronic Aids
SI000CK INSTRUCTION MANUAL, Electronic Aids
DCA Transparency T-19-1

PROCEDURE FOR THE ACTIVITY

1. STUDENT ACTIVITY-- Complete the following activities:

   Day 1: EAI000 Experiment #5: Electricity and magnetism produce mechanical motion
   CONCEPTS of ELECTRICITY pages 19-22.

   Day 2: SI000CK Experiment # 25: Using electrical current to heat materials
   SI000CK INSTRUCTION MANUAL pages 141-143.

   SI000CK Experiment #29: Creating and controlling light that is produced directly from electricity.
   SI000CK INSTRUCTION MANUAL pages 158-163.

   Day 3: SI000CK Experiment #20: Charging a wet cell
   SI000CK INSTRUCTION MANUAL pages 115-123.

   Day 4: SI000CK Experiment #21: Charging a cheese cell
   SI000CK INSTRUCTION MANUAL pages 124-125

   Day 5: SI000CK Experiment #24: Building a cheese battery for operating a transistor radio
   SI000CK INSTRUCTION MANUAL pages 130-137.

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SECTION V. Power Conversion

ACTIVITY
"Converting Chemical to Radiant, to Thermal, and to Electrical Energy"

Allow I class period

OBJECTIVE: At the end of the discussion the students will understand the concepts of chemical to radiant, to thermal, and to electrical conversion as evidenced by the teachers records.

EQUIPMENT AND SUPPLIES NEEDED: Dry cell, lamp, switch, wires

REFERENCE MATERIAL: SI000CK INSTRUCTION MANUAL, Electronic Aids, pages 48 and 49.

PROCEDURE FOR THE ACTIVITY

1. Teacher Discussion
    1. Explain that chemical to thermal conversion would be forms of combustion and chemical reactions.
       Give examples.
    2. Explain that chemical to radiant conversion would be chemical reactions and combustion
       Give examples. Discuss the "gray area" between thermal & radiant energy.
    3. Discussion of chemical to electrical conversion
        A. Cells & Batteries
        B. Types of cells
        C. Use of batteries

2. Teacher Demonstration
    1. Demonstrate simple circuit using a dry cell, lamp, and switch (same as a flashlight).

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SECTION V. Power Conversion

ACTIVITY
"Converting Chemical to Radiant, to Thermal, and to Electrical Energy"

Allow 6 class periods

OBJECTIVE: At the end of the activities of study, the student will understand the general concepts of chemical to electrical conversions and parallel and series circuitry as evidenced by the teachers records of successful completion of required activities.

EQUIPMENT AND SUPPLIES NEEDED: Electronic Aids 1000 and Electronic Aids S1000CK Trainers

REFERENCE MATERIAL: CONCEPTS of ELECTRICITY, Electfonic Aids
S1000CK INSTRUCTION MANUAL, Electronic Aids

PROCEDURE FOR THE ACTIVITY

1. STUDENT ACTIVITY--Complete the following activities:

   Day 1: EA1000 Experiment #40: Cells in Series
   CONCEPTS of ELECTRICITY pages 153-156

   Day 2: EA1000 Experiment #41: Cells in Parallel
   CONCEPTS of ELECTRICITY pages 157-160

   Day 3: EA1000 Experiment #7: Chemical Action Produces Electricity
   CONCEPTS of ELECTRICITY pages 26-30

   *Day 4: S1000CK Experiment #16: Building a Cheese Cell
   S1000CK INSTRUCTION MANUAL pages 92-97

   *Day 5: S1000CK Experiment #17: Building Cells from Fruits and Vegetables
   S1000CK INSTRUCTION MANUAL pages 98-101

   *Day 7: S1000CK Experiment #19: How the Use of the Electrode Affects the Production of Current
   S1000CK INSTRUCTION MANUAL pages 109-113

*—These days could be demo only instead of student activity

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SECTION V. Power Conversion

ACTIVITY
Thermal to Mechanical, to Radiant, and to Electrical Conversions

Allow 1 class period

OBJECTIVE: At the conclusion of the activity, the student will understand the concepts of thermal to mechanical, to radiant, and to electrical conversion as evidenced by the teachers record.

EQUIPMENT AND SUPPLIES NEEDED: Copper wire, volt meter, small torch or EA1000 Student Trainer

REFERENCE MATERIAL: S1000CK INSTRUCTION MANUAL, Electronic Aids, page 32 & the 1st and 2nd paragraphs of page 33

DCA Transparencies: T-13-1, T-14-1, T-14-2, T-15-1, T-15-2, T-16-4, T-18-1, T-17-1, T-17-2, T-17-3

PROCEDURE FOR THE ACTIVITY

1. Discussion
    1. Discuss how the internal combustion engine converts thermal to mechanical energy
    2. Discuss how heat applied to a thermocouple can produce electricity
    3. Discuss the correlation between thermal and radiant energy
        A. an object when heated sufficiently will emit light

2. Teacher Demonstration
    1. Demonstrate a thermocouple
       Experiment #26 S1000CK INSTRUCTION MANUAL, pages I45, I46, I47

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SECTION V. Power Conversion

ACTIVITY
"Converting Thermal to Mechanical Energy"

Allow 6 class periods

OBJECTIVE: At the completion of this activity the student will demonstrate his knowledge of the engine as a converter of thermal to mechanical energy as evidenced by the teachers records of completed activities.

EQUIPMENT AND SUPPLIES NEEDED: Dynometer with Air/Fuel measuring devices, diesel engine, rotary engine, 2 cycle engine, 4 cycle engine

REFERENCE MATERIAL: GENERAL POWER MECHANICS by Worthington, Units 36, 71, and 99
DCA TRANSPARENCIES T-13-1, T-17-1, T-17-2, T-17-3, T-17-4, AM-6.

PROCEDURE FOR THE ACTIVITY

1. Teacher Discussion
   1. Discuss basic principles of the diesel, rotary, 2 cycle & 4 cycle engines
2. Teacher Demonstration
   1. Demonstrate the operation of the dynomometer and air/fuel measuring devices
3. Student Activity
   1. Connect engine to dynometer and measure: A. Torque
      B. Horsepower
      C. Air/fuel consumption
      D. Efficiency

   The Student should complete the same procedure for each engine (2 cycle, 4 cycle, rotary, diesel)
4. The teacher should discuss comparisons of the efficiency of all engines at the conclusion of activity.

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SECTION V. Power Conversion

ACTIVITY
"Converting Nuclear to Thermal and to Radiant Energy"

Allow 1 class period

OBJECTIVE: At the completion of the activity, the student will understand the concepts of nuclear conversion as evidenced by the teachers records.

EQUIPMENT AND SUPPLIES NEEDED: Film projector

REFERENCE MATERIAL: GENERAL POWER MECHANICS by Worthington Unit 94, 95, 96

PROCEDURE FOR THE ACTIVITY

1. Discussion/Demonstration
   A. Discuss nuclear fusion
      A. Principles
      B. Uses

   B. Discuss nuclear fission
      A. Principle
      B. Uses

   C. If possible have a speaker from the local Power & Electric Company speak on the uses of nuclear energy for electrical production in the future

   D. Obtain and show the film: ATOMIC ENERGY
      Prentice-Hall, Englewood Cliffs, New Jersey

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SECTION V. Power Conversion

ACTIVITY
General–Radiant/Chemical, Thermal Electrical Conversion

Allow 1 class period

OBJECTIVE: The student will understand the concepts of radiant to chemical, thermal and electrical conversion by participating in the class discussion at the conclusion of the unit as evidenced by the teachers records.

EQUIPMENT AND SUPPLIES NEEDED: Electronic Aids 1000 Student Trainer

REFERENCE MATERIAL: GENERAL POWER MECHANICS by Worthington, Unit 101

PROCEDURE FOR THE ACTIVITY

1. The purpose of this activity is to show the concepts of how radiant energy can be converted to chemical, thermal, and electrical energy.

2. Discussion/Demonstration

   A. Discussion of radiant to chemical conversion
      1. Photosynthesis
   B. Discussion of radiant to thermal conversion
      1. If possible demonstrate a simple Boy Scout furnace that converts radiant energy to thermal energy.
   C. Discuss radiant to electrical conversion with the use of a solar cell.

3. Student Activity

   Copy EA2 and Ea13

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SECTION V

MECHANICAL TRANSMISSION

5 DAYS OF ACTIVITIES

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SECTION V. Mechanical Transmission

ACTIVITY
"Why Things Move"

Allow 1 class period

OBJECTIVE: At the completion of this activity, the student will understand how force, equilibrium and motion are related to Inertia as evidenced by correct responses to lesson questions.

EQUIPMENT AND SUPPLIES NEEDED: McKnight & McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL by Bohn & MacDonald, Mc.& Mc. Publishing Co., pages 23-26 and 36-38
MECHANICAL CONTROL, Student Lab Manual, pages M9-45 to M1-51

PROCEDURE FOR THE ACTIVITY

1. Teacher Discussion
   A. Why things Move
2. Student Activity
   A. Complete Experiment M1 in MECHANICAL CONTROL Lab Manual

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SECTION V. Mechanical Transmission

ACTIVITY
"Using the Lever to Gain Strength"

Allow 1 class period

OBJECTIVE: At the completion of this activity, the student will learn the mechanical advantage of lever and incline planes as evidenced by the student answers to lesson questions.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL by Bohn & MacDonald, Mc & Mc Publishing Co., pages 38-42.
MECHANICAL CONTROL Student Lab Manual, pages M3-56 to M3-60.

PROCEDURE FOR THE ACTIVITY

1. Teacher Discussion
   A. Using the lever to gain strength

2. Student Activity
   A. Complete Experiment M3 in MECHANICAL CONTROL Lab Manual

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SECTION V. Mechanical Transmission

ACTIVITY
"Producing Directional Change with Belts & Chains"

Allow 1 class period

OBJECTIVE: At the completion of the experiment, the student will demonstrate his knowledge of producing directional change with belts and chains by successfully completing Experiment #05.

EQUIPMENT AND SUPPLIES NEEDED: McKnight & McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL by Bohn & MacDonald, Mc & Mc Publishing Co.,
POWER SYSTEMS, Student Lab Manual

PROCEDURE FOR THE ACTIVITY

1. Teacher Discussion
   A. Idler pulleys can be used to carry belts past obstructions or around corners
   B. Idler pulleys do not affect the mechanical advantage of pulley systems
   C. Pulleys can be used for on-off switching
   D. Pulleys can reverse direction
   E. Pulleys can produce directional change.

2. Student Activity
   A. Complete Experiment #05 in POWER SYSTEMS, Student Lab Manual, pages 05-310 to 05-312

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SECTION V. Mechanical Transmission

ACTIVITY
"Mechanical Advantage of Machines"

Allow 1 class period

OBJECTIVE: At the completion of this activity, the student will understand mechanical advantage as evidenced by successfully completing the assigned activity.

EQUIPMENT AND SUPPLIES NEEDED: McKnight & McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONVERSION, by Bohn & MacDonald, page 36-38
POWER SYSTEMS–Student Lab Manual, pages 03-300 –03-303

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete experiment 03-300 in POWER SYSTEMS Lab Manual, pages 03-300 to 03-303

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ACTIVITY
"Friction as a Holding Force"

Allow 1 class period

OBJECTIVE: At the completion of the activity, the student will demonstrate his knowledge of friction as evidenced by successfully completing the experiment.

EQUIPMENT AND SUPPLIES NEEDED: McKnight & McKnight Power Experimenter

REFERENCE MATERIAL: POWER SYSTEMS Student Lab Manual by Bohn & MacDonald, pages 01-292 to 01-294

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete Experiment 01 in POWER SYSTEMS, Student Lab Manual, pages 01-292 to 01-294

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FLUID TRANSMISSION

8 DAYS OF ACTIVITIES

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SECTION V. Fluid Transmission

ACTIVITY
"Controlling Fluids with Shut-off and Check Valves"

Allow 1 class period

OBJECTIVE: At the completion of the activity, the student will understand check valves as evidenced by his written answers to the questions in the assigned experiment.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL by Bohn & MacDonald, pages 91-93 & 100

FLUID CONTROL, Student Lab Manual, pages F3-123 to F3-125

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete Experiment F3 in FLUID CONTROL, Student Lab Manual, pages F3 123 to F3-125

2. Teacher--Refer to Teachers Guide for review questions

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SECTION V. Fluid Transmission

ACTIVITY
"Producing & Measuring a Vacuum"

Allow 1 class period

OBJECTIVE: At the completion of the activity, the student will know that a vacuum is negative pressure as evidenced by correctly answering the questions in the experiment.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL by Bohn & MacDonald, pages 62-66
FLUID CONTROL, Student Lab Manual, pages F2-118 to F-122

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete Experiment F2 in FLUID CONTROL, Student Lab Manual, pages F2-118 to F2-122

2. Teacher--Review questions and answers in Teachers manual

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SECTION V. Fluid Transmission

ACTIVITY
"Pressure and Vacuum"

Allow 1 class period

OBJECTIVE: At the completion of this activity, the student will know how motion can be used to develop a pressure or a vacuum as evidenced by correctly answering the questions in the experiment.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL, by Bohn & MacDonald, pages 75-90
FLUID CONTROL, Student Lab Manual, pages F5-133 to F5-136

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete experiment F5 in FLUID CONTROL, Student Lab Manual, pages F5-133 to F5-136

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SECTION V. Fluid Transmission

ACTIVITY
"Using Pressure to Provide Force with a Cylinder"

Allow 1 class period

OBJECTIVE: At the completion of the activity, the student will know that pressure and vacuum are created, controlled and utilized in a system as evidenced by correctly answering questions in the assigned experiment.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL, by Bohn & MacDonald, pages 66-74
FLUID CONTROL, Student Lab Manual, pages F4-128 to F4-132

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete experiment F4 in FLUID CONTROL, Student Lab Manual, pages F4-128 to F4-132

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SECTION V. Fluid Transmission

ACTIVITY
"Fluid Control of Motor Operation"

Allow 1 class period

OBJECTIVE: At the completion of the activity, the student will demonstrate his knowledge of fluid control of motor operation by completing the questions in the experiment successfully.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER SYSTEMS, Student Lab Manual, pages C3-259 to C3-262

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete experiment C3 from POWER SYSTEMS, Student Lab Manual, pages C3-259 to C3-262

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SECTION V. Fluid Transmission

ACTIVITY
"Controlling a Conveyor"

Allow 2 class periods

OBJECTIVE: At the completion of the activity, the student will demonstrate his understanding of how interrupted motion can be produced by building and controlling a conveyor as evidenced by successful completion of the experiment.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimentor

REFERENCE MATERIAL: POWER SYSTEMS, Student Lab Manual, pages C9-282 to C9-285

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete experiment C9 in POWER SYSTEMS, Student Lab Manual, pages C9-282 to C9-285

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SECTION V. Fluid Transmission

ACTIVITY
"Producing and Measuring Fluids Under Pressure"

Allow 1 class period

OBJECTIVE: At the completion of the activity, the student will know the definitions of force and pressure as evidenced by correct written answers to lesson questions.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL, by Bohn & MacDonald, pages 62-66
FLUID CONTROL, Student Lab Manual, pages F1-113 to F1-117

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete experiment F1 in FLUID CONTROL, Student Lab Manual, pages F1-113 to F1-117

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ELECTRICAL TRANSMISSION

7 DAYS OF ACTIVITIES

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SECTION V. Electrical Transmission

ACTIVITY
"Generating Electricity with Motion"

Allow 1 class period

OBJECTIVE: At the completion of the activity, the student will demonstrate his knowledge of how electricity comes from motion as evidenced by successfully producing electricity with motion in the assigned activity.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL by Bohn & MacDonald, pages I21-130
ELECTRICAL CONTROL, Student Lab Manual, pages E6-198 to E6-203

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete Experiment E6 in ELECTRICAL CONTROL, Student Lab Manual, pages E6-198 to E6-203

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SECTION V. Electrical Transmission

ACTIVITY
"Controlling Electrical Circuit with Relays and Switches"

Allow 2 class periods

OBJECTIVE: At the completion of the activity, the student will demonstrate his knowledge of controlled electrical circuits as evidenced by successfully completing the assigned activity.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL by Bohn & MacDonald, pages 135-136, 140-142, 151-152
ELECTRICAL CONTROL, Student Lab Manual, pages E10-223 to E10-227

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete experiment E10 in ELECTRICAL CONTROL, Student Lab Manual, pages E10-223 to E10-227

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SECTION V. Electrical Transmission

ACTIVITY
"Controlling Circuits from more than One Location"

Allow 1 class period

OBJECTIVE: At the completion of this activity the student will demonstrate his knowledge of how to control electrical circuits as evidenced by the successful completion of the assigned activity.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL by Bohn & MacDonald, pages 134-135
ELECTRICAL CONTROL, Student Lab Manual, pages E4-187 to E4-190

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete experiment E4 in ELECTRICAL CONTROL, Student Lab Manual, pages E4-187 to E4-190

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SECTION V. Electrical Transmission

ACTIVITY
"Using Series and Parallel Circuits"

Allow 1 class period

OBJECTIVE: At the completion of the activity, the student will demonstrate his knowledge of the different types of electrical circuits as evidenced by the successful completion of the experiment.

EQUIPMENT AND SUPPLIES NEEDED McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROL by Bohn & MacDonald, pages 130-132
ELECTRICAL CONTROL, Student Lab Manual, pages E2-176 to E2-181

PROCEDURE FOR THE ACTIVITY

1. Student Activity
   A. Complete experiment E2 in ELECTRICAL CONTROLS, Student Lab Manual, pages E2-176 to E2-181

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SECTION V. Electrical Transmission

ACTIVITY
"Braking Circuits"

Allow 1 class period

OBJECTIVE: At the completion of the activity, the student will demonstrate his knowledge of mechanical braking action and circuits as evidenced by successfully completing the assigned activity.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER SYSTEMS, Student Lab Manual, pages O11-333 to O11-336

PROCEDURE FOR THE ACTIVITY

1. Teacher Discussion
   A. Magnetism and its uses

2. Student Activity
   A. Complete experiment O11 in POWER SYSTEMS, Student Lab Manual, pages O11-333 to O11-336

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SECTION V. Electrical Transmission

ACTIVITY
"Developing a Transformer"

Allow 1 class period

OBJECTIVE: At the completion of the activity, the student will demonstrate his knowledge of transformers as evidenced by successfully completing the assigned activity.

EQUIPMENT AND SUPPLIES NEEDED: McKnight Power Experimenter

REFERENCE MATERIAL: POWER: MECHANICS of ENERGY CONTROLS by Bohn & MacDonald, pages 143-147 and 151-154
POWER SYSTEMS, Student Lab Manual, pages O15-354 to O15 to 358

PROCEDURE FOR THE ACTIVITY

1. Teacher Discussion
   A. Sub-stations

2. Student Activity
   A. Complete experiment O15 in POWER SYSTEMS, Student Lab Manual, pages O15-354 to O15-358

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SECTION VI

SYNTHESIS OF POWER SYSTEMS

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SECTION VI. Synthesis of Power Systems

ACTIVITY
"Synthesis Problem"

Allow 14 class periods

OBJECTIVE: The student will design, construct and operate a power system that will solve the teacher designed problem in the most efficient and practical manner within 14 days as evidenced by the teachers records.

EQUIPMENT AND SUPPLIES NEEDED: All equipment and supplies used for conversion and transmission activities

REFERENCE MATERIAL: Any and/or all reference material used during course.

PROCEDURE FOR THE ACTIVITY

1. Teacher Information
   A. The purpose of the Synthesis Problem is to give the student a problem that involves a total power system. The students have been working with single activities in conversion and transmission. This problem allows the students to be creative in designing their own system.

   B. Define problems for the synthesis of power that can be solved with the facilities, equipment, and materials available.

2. Student Activity
   PROBLEM: Design, construct and operate a power system that is capable of moving a 6 ounce rectangular solid weight 6 inches vertically and returning it under power. This is to occur at the rate of 10 movements per minute.

   Day One: 1. Explain the problem to the class. The following factors should be emphasized:
      A. Simplicity of design
      B. Efficiency of system
      C. Life and maintenance of system
      D. Cost of system
      E. Availability of energy source

   2. Power sources may include items such as small engines, electric motors, etc.

   Day Two, Three, Four, and Five:
   1. Help students with design problems. Each student should complete a refined sketch or working drawing of his solution to the problem.

   Day Six - Twelve:
   1. Students should construct their power systems
   2. Any number of items can be used, such as plastic gears, wooden cams, etc.
   3. The student should indicate the proper material that would be used in an industrial situation.
   4. The teacher must emphasize safety on those pieces of equipment that may be used for the construction of the systems.

   Day Thirteen and Fourteen:
   1. Have students operate and explain their power systems to the class.

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SECTION VII

INDEPENDENT STUDY

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SECTION VII. Independent Study

ACTIVITY
"Independent Study"

Allow 14 Class periods

OBJECTIVE: At the completion of 14 days the student will have successfully completed all requirements contained in the individual study contract as evidenced by instructor approved signature.

EQUIPMENT AND SUPPLIES NEEDED: Existing shop facilities and equipment

REFERENCE MATERIAL: Any and/or all reference material used during the course.

PROCEDURE FOR THE ACTIVITY

1. Teacher Information
   A. The purpose of the independent study activity is to allow the students an opportunity to work in an area of their own interest or need that is related to the study of power.

   B. Procedure:

Day One:
1. Explain and have students complete the contract on the following page.
2. The actual working days for the contract will be 12 days--one of the 14 days will be used to complete the contract. The remaining day will be used to give oral reports.
3. Two copies of the contract should be completed by each student. The student should have one copy with him in class each day. The other copy is for the teachers record.
4. The daily log on back of the contract should be completed each day by the students so the teacher will be aware of the actual work completed by the student that day.
5. If the student is to build a project, a set of plans and material costs should be attached to the contract.
6. The scope of the contract should be related to the power area. The teacher should check carefully to see that the student does not begin a task that is too lengthy, difficult or one that cannot be completed within the facilities of the school.
7. Possible areas of contract work: designing and building model rockets--minor maintenance and overhaul of small engines--advanced experiments on any of the equipment used in the course--research reports on any topic of power--career research- electrical kits - research on transportation systems - etc.

Days 2–13: The teacher should individually help solve student problems with their contract work.

Day 14: Have each student show their contract work to the class and give a 1 to 2 minute oral report concerning their work.

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Independent Study Contract

This agreement
made this_____day of_____in the year of Nineteen Hundred and_____.

By and Between

_____Here after called the Independent Study Student, and
_____Here after called the Instructor.

Witnesseth,
That whereas the Independent Study Student intends to study, plan and/or organize:

Witnesseth,
That whereas the Independent Study Student intends to build or fabricate:

Now, therefore,
The Independent Study Student and the Instructor, for the considerations here after named, agree as follows:

ARTICLE I: THE WORK TO BE DONE AND THE DOCUMENTS FORMING THE CONTRACT:
The Independent Study Student agrees to provide all the labor, pay for all materials and to do all things necessary for the proper completion of the work shown above and described on the attached plans.

ARTICLE II: TIME OF COMPLETION
The work to be performed under this contract shall commence and be completed as follows:
Beginning Date_____Final Completion Date_____

ARTICLE III: CONTRACT REPORT
The Independent Study Student agrees to give to the class a short oral report concerning his contract work at the completion of the contract.

ARTICLE IV:
The Instructor agrees to provide minor assistance to the Independent Study Student upon request by Student.

Signed:_____ _____
Independent Study Student Instructor

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SECTION VIII

CONCLUSIONS

ENDING THE COURSE

DAY ONE: Administer Post Test* (Appendix E). Evaluate.

DAY TWO: Teacher should have students clean and repair equipment. Inventory should be taken and parts of equipment missing should be replaced. Oil in engines should be changed and engines should be placed in storage.

Teacher should complete the normal end of the year or course clean up.

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APPENDIX A

DEFINITION OF BEHAVIORAL OBJECTIVES

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*The three levels of behavioral objectives are: cognitive, affective, and psychomotor. To describe the variable of cognitive and affective benavior, definitions from Bloom and Kratwohl are utilized. The definitions for psychomotor behavior are those described by Dave.

Cognitive Variables: Behaviors which place primary emphasis on the mental or intellectual process of the learner:
The levels are:

Knowledge- Involves the recognition and recall of facts (i.e., defining terms, recalling names, dates, persons, indentifying words, etc.)

Comprehension- The learner interprets, translates, summarizes, or paraphrases given material into another language or form of communication (i.e., reading a book or musical scores, grasping the thought of material studied, ability to describe something in one's own words, etc.)

Application- Involves the use of material in a situation which is different from that situation in which it was originally learned (i.e., the use of abstract ideas, principles, or theories in problem-solving).

Analysis- Involves separating a complex entity into its parts, drawing comparisons and relationships between the elements (i.e., ability to recognize assumptions, to distinguish cause and effect relationships, reorganization of biases or points of view, etc.)

Synthesis- Involves combining elements to form a new original entity. It involves a process of working with pieces, parts, elements, etc., and arranging them in a structure that was not clearly evidenced before (i.e. ability to produce a play, music, art forms, design products, or formulate solutions).

Evaluation- Involves acts of decision-making, judging, or selecting based on a given

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Synthesis cont.

set of criteria. These criteria may be objective or subjective (i.e. ability to indicate fallacies, compare a work or an idea with known standards, etc.)

Affective variables: Behavior which primarily emphasizes attitudes, emotions, and values of the learner and are usually reflected by interests, appreciations, and adjustments. The levels are:

Receive- The learner is aware of, or passively attending to certain phenomena and stimuli (i.e., listening, being attentive to, etc.)

Respond-- The learner complies to given expectations by attending or reacting to certain stimuli or phenomena (i.e., obeys or participates as expected, etc.)

Value- The learner displays behavior consistent with a single belief or attitude in situations where he is not forced to comply or obey (i.e., demonstrates a definite preference, displays a high degree of certainty and conviction, etc.)

Organization* The learner is committed to a set of values as he displays or communicates his beliefs or values (i.e. develops a rationale for a set of values, makes judgments about sets of values).

Characterization*-The total behavior of the learner is consistent with the values he has internalized (i.e., develops a consistent philosophy of life, exhibits respect for the worth and dignity of human beings, etc.).

* Levels four and five are seldom used in performance objectives at the instructional level. Therefore, the educator may find these levels inappropriate for us in writing performance objectives to be achieved over short time periods.

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Definitions cont.

Psychomotor Variables: Behaviors which place primary emphasis on neuro-muscular or physical skills involving various degrees of physical dexterity. The levels are:

1. Imitation- When the learner is exposed to an observable action, he begins to make covert imitation of that action. Such covert behavior appears to be the starting point in the growth of psychomotor skill. This is then followed by overt performance of an act and capacity to repeat it. This performance, however, lacks neuromuscular coordination or control, and hence is generally in a crude and imperfect form (i.e., impulse, over repetition).

2. Manipulation- Emphasizes the development of skill in following directions, performing of selected actions, and fixation of performance through necessary practice. At this level, the learner is capable of performing an act according to instruction rather than just on the basis of observation as in the case at the level of imitation (i.e., following directions).

3. Precision- The proficiency of performance reaches a higher level of refinement in reproducing a given act. The learner performs the skill independent of a model or a set of directions. Here, accuracy, proportion, and exactness in performance become significant (i.e., reproduction, control, errors reduced to a minimum).

4. Articulation-Emphasizes the coordination of a series of acts by establishing appropriate sequence and accomplishing harmony or internal consistency among different acts (i.e., performance involves accuracy and control plus elements of speed and time).

5. Naturalization- A high level of proficiency in the skill of performance of a single act is required. The behavior is performed with the least expenditure of psychic energy. The act is routinized to such an extent that it results in automatic and spontaneous response (i.e., performance becomes natural and smooth).

* Developing and Writing Performance Objectives, Booklet #2, Educational Innovators Press, P.O. Box 13052, Tucson, Arizona, 1971.

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APPENDIX B

DEFINITION OF TERMS

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DEFINITIONS OF POWER TERMS

1. Chemical Energy—Movements of Ions.
2. Conversion—Changing energy from one form to another.
3. Efficiency—Ratio of input to output.
4. Energy—Ability to do work——produce motion, heat, and light.
5. Electrical Energy—Movement of Electrons.
6. Fludics—Control of fluids with no moving parts.
7. Fluid power—Power involving any gas or liquid.
8. Force—The exertion in units.
9. Heat Engines—A physical apparatus capable of converting heat energy to mechanical energy by either internal or external combustion.
10. Horsepower—Measurement of mechanical Power.
11. Machine—Any device consisting of two or more related parts that transmit or modify force and motion to do work.
12. Mechanical Energy—Motion or Movement of Molecules.
13. Mechanical Friction—Resistance to movement between two (2) surfaces that are touching each other.
14. Nuclear Energy—Movement of Subatomic Particals Ex. Pimesons, etc.
15. Power—Rate of conversion of energy.
16. Power Mechanics—The area of power concerned with mechanical devices.
17. Pressure—Force per unit area.
18. Prime Mover—Any device that converts natural energy into a more usable form of energy.
19. Radiant Energy—Movement of Photons.
20. Source—Origin within the system.
21. System—A complete set of principles, ideas, or parts organized or arranged in a rational manner.
22. Thermal Energy—Movement of Photons.
23. Transmission—Transferring from source to use (mode of Movement).
24. Torque—Measure of turning effort—not requiring movement.
25. Utilization—Employment of application of power to do work, produce motion, light, and heat with a profitable outcome.
26. Work—Force x distance (measurement).

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APPENDIX C

S.E.T. PROJECT

POWER CURRICULUM

ATTITUDE INVENTORY TEST

ATTITUDE INVENTORY TEST ANSWER SHEET

ATTITUDE INVENTORY TEST EVALUATION PROCEDURE AND KEY

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S.E.T. PROJECT
POWER CURRICULUM
ATTITUDE INVENTORY

Read the statements carefully and answer all statements on the answer sheet. Circle the "yes" response if you agree; circle the "no" response if you disagree; circle the "undecided" (und.) if you do not know. There is no right or wrong answer. The result will not affect your grade and will be held in confidence. Please answer honestly.

1. Physical education is more fun than the power and energy class.
2. Electrical power plants are not contributors to air pollution.
3. Power is a small part of industry today.
4. I am afraid of electricity.
5. I enjoy working with small engines.
6. Most gasoline engines are efficient.
7. I want to be a mechanic.
8. The power and energy course will help me in my future career choice.
9. I would never want to be an electrician.
10. The supply of energy is unlimited.
11. I dislike getting my hands dirty.
12. Working with ones hands is an undesirable characteristic of the occupations in power and energy.
13. I like to work with combinations of the simple machines.
14. I understand and appreciate the value of simple hydraulic systems.
15. The power and energy course should emphasize the maintenance and repair of small gasoline engines.
16. Power and energy courses do not use the content taught in mathematics, science, etc.
17. Safety need not be emphasized in power and energy classes because of the limited number of machines used.
18. Power and energy is more fun than building products in the materials and processes classes.
19. Power and energy does not make use of communications technology.
20. Power systems of today are essential factors in our present standard of living.

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Attitude Inventory cont.

21. The study of gears, pulleys, levers, chains, etc. does not belong in the study of power and energy.

22. I prefer to work as a group member rather than individually in power and energy.

23. I would rather have the power and energy class taught by the lecture-demonstration method as compared to student activities.

24. Power and energy is an important part of school work.

25. Talking about power and energy is something I like to do.

26. Power and energy classes have helped me to think about my future.

27. This power and energy class is a lot of nonsense.

28. I feel comfortable in the power and energy class.

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ATTITUDE INVENTORY ANSWER SHEET

DATE _____ HOUR _____ NAME _____

CLASS _____ _____ STUDENT # _____

INSTRUCTIONS:
Circle the "yes" response if you agree with the statement; circle the "no" response if you disagree with the response; circle the "undecided" if you do not know.

1.	No	Undecided	Yes	15.	No	Undecided	Yes
2.	No	Undecided	Yes	16.	No	Undecided	Yes
3.	No	Undecided	Yes	17.	No	Undecided	Yes
4.	No	Undecided	Yes	18.	No	Undecided	Yes
5.	No	Undecided	Yes	19.	No	Undecided	Yes
6.	No	Undecided	Yes	20.	No	Undecided	Yes
7.	No	Undecided	Yes	21.	No	Undecided	Yes
8.	No	Undecided	Yes	22.	No	Undecided	Yes
9.	No	Undecided	Yes	23.	No	Undecided	Yes
10.	No	Undecided	Yes	24.	No	Undecided	Yes
11.	No	Undecided	Yes	25.	No	Undecided	Yes
12.	No	Undecided	Yes	26.	No	Undecided	Yes
13.	No	Undecided	Yes	27.	No	Undecided	Yes
14.	No	Undecided	Yes	28.	No	Undecided	Yes

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KEY FOR EVALUATING ATTITUDE INVENTORY

The following statements should be considered positive with a "yes" response:

1, 5, 8, 10, 14, 18, 20, 25, 26, 28.

The following statements should be considered positive with a "no" response:

2, 3, 6, 15, 16, 17, 19, 21, 27.

The affective Performance Objective stated that a 15% positive increase in attitude would be obtained between the S.E.T. Project Pre and Post attitude inventory test.

In order to determine whether or not this positive increase has been reached you must compare the results of the students pre-test score with the students post- test score on the Attitude Inventory Test.

To meet the objective at least four of the students Post Test responses must change positively.

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APPENDIX D

S.E.T. PROJECT
POWER CURRICULUM

PRE TEST

PRE TEST ANSWER SHEET

PRE TEST KEY AND EVALUATION PROCEDURE

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TEST FOR POWER

INSTRUCTIONS: ANSWER ALL QUESTIONS ON THE ANSWER SHEET.

1. The "Wankel" engine is:

   A. reciprocating internal combustionengine
   B. an external combustion engine
   C. a rotary engine
   D. a steam engine

2 If a lever is to be used as an effective pry bar, the pivot point should be:

   A. near the applied force
   B. equal distance from each end of the bar
   C. near the middle of the bar
   D. near the object to be moved

3. A multi-meter (VOM) can be used to measure:

   A. hydraulic line pressure
   B. voltage
   C. toique
   D. air pressure

4. The viscosity of oil refers to its ability to:

   A. burn
   B. conduct electricity
   C. flow
   D. resist oxidation

5. A dry cell converts _____ energy into electrical energy.

   A. chemical
   B. mechanical
   C. thermal
   D. radiant

6. Which of the following items is the best electrical insulator?

   A. glass
   B. copper
   C. water
   D. aluminum

7. A switch is a device to _____ power.

   A. control
   B. transmitt
   C. convert
   D. process

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8. Gasoline is obtained:

   A. directly from the earth
   B. by refining crude oil
   C. from man-made materials
   D. from burning inorganic materials

9. Ecologically, an undesirable by-product of the internal combustion engine is:

   A. torque
   B. water
   C. hydrocarbon emissions
   D. steam

10. Solar furnaces generally convert radiant energy to_____ energy.

   A. electrical
   B. nuclear
   C. thermal
   D. chemical

11. Bearings are used to:

   A. reduce friction
   B. reduce repair frequency
   C. increase efficiency
   D. all of the above

12. Nuclear reactor is to nuclear energy as the battery is to_____ energy.

   A. chemical
   B. mechanical
   C. radiant
   D. thermal

13. Chemical energy can be converted into electrical energy by a:

   A. fuel cell
   B. solar cell
   C. transducer
   D. dynomometer

14. Which of the following conversion methods will not create direct electrical current:

   A. solar cell
   B. a chemical battery
   C. a rotating magnet
   D. a thermo-couple

15. The pump is to a hydraulic system as the_____is to an electrical system.

   A. generator
   B. relay
   C. switch
   D. electrical power line

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16. A switch is to an electrical circuit as a _____ is to a hydraulic system.

A. cylinder
B. valve
C. pump
D. coupler

17. A flourescent bulb converts electrical energy into:

A. sound energy
B. thermal energy
C. mechanical energy
D. radiant energy

18. A generator converts____energy to electrical energy.

A. mechanical
B. thermal
C. linear
D. chemical

19. If a lever is to be used as an effective pry bar, the pivot point should be:

A. near the applied force
B. equal distance from each end of the bar
C. near the middle of the bar
D. near the object to be moved

20. Ecologically, an undesirable by-product of the internal combustion engine is:

A. torque
B. water
C. hydrocarbon emissions
D. steam

21. A dry cell converts_____ energy into electrical energy.

A. chemical
B. mechanical
C. thermal
D. radiant

22. A switch is to an electrical circuit as a_____ is to a hydraulic system.

A. cylinder
B. valve
C. pump
D. coupler

23. A V-belt will keep its tension better than a flat belt because of:

A. wedge action of belt to pulley
B. more surface contact
C. greater flexibility
D. greater thickness of V belt

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24. Force increase and speed decrease can be achieved by:

A. driving a small sprocket by a large sprocket
B. two sprockets of equal size
C. driving a large sprocket by a small sprocket
D. can not be achieved

25. The rate of conversion of energy is:

A. power
B. torque
C. work
D. horsepower

26. The viscosity of oil refers to its ability to:

A. burn
B. conduct electricity
C. flow
D. resist oxidation

27. Solar furnaces generally convert radiant energy to_____energy.

A. electrical
B. nuclear
C. thermal
D. chemical

28. Torque is:

A. the same as horsepower
B. turning force
C. associated with non-powered equipment
D. weight x time x distance

29. A solar cell converts:

A. Radiant energy to electrical energy
B. Radiant energy to thermal energy
C. Radiant energy to chemical energy
D. thermal energy to chemical energy

30. Which is not an example of a resistor?

A. switch
B. fuse
C. transistor
D. rheostat

31. A cam changes:

A. rotary to reciprocating motion
B. reciprocating to rotary motion
C. neither of these
D. both of these

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32. The term fluidics refers to:

A. only liquids
B. the control of fluids with no moving parts
C. electricity
D. pressure without movement

33. The main purpose of a motor is to convert electrical energy to_____energy.

A. mechanical
B. radiant
C. thermal
D. chemical

34. The difference between the output of an A.C. generator and an alternator is:

A. the alternator output is D.C.
B. no difference
C. the alternator produces only voltage
D. there is no such object as an A.C. generator

35. Electrical power lines and pneumatic lines are similar in that they:

A. are made of metal
B. carry a liquid
C. transmit power
D. are used

36. A gear can be used:

A. to change direction of rotation
B. as a slip clutch
C. as a reciprocating
D. as an energy converter

37. A one-way valve is to the hydraulic system as a_____is to an electrical system.

A. resistor
B. rheostat
C. transformer
D. diode

38. The saleable measurement for electricity is:

A. kilovolt/hours
B. hiloamper/hours
C. kilowatt/hours
D. kiloohm/hours

39. Force increase and speed decrease can be achieved by:

A. driving a small sprocket by a large sprocket
B. two sprockets of equal size
C. driving a large sprocket by a small sprocket
D. can not be achieved

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40. Pressure drop in hydraulic and pneumatic lines is caused by:

A. friction
B. plastic lines
C. high atmospheric pressure
D. pump action

41. When in an enclosed area, exhaust gases from an internal combustion engine should be:

A. filtered
B. cooled
C. exhausted outside
D. directed back into the engine

42. Nuclear energy can be converted to heat through the use of:

A. solar batteries
B. bi-metalic elements
C. pressure water reactor
D. solenoids

43. If you had to design a system to heat your home for the year 2000, what source of energy would probably be most realistic?

A. mechanical
B. electrical
C. radiant
D. chemical

44. Diesel engines would be an example of:

A. compression ignition engine
B. spark ignition engine
C. linear engine
D. sterling engine

45. The spark plug ignites the fuel-air mixture near the end of the _____ stroke.

A. intake
B. compression
C. power
D. exhaust

46. Which of the following methods would be most realistic in curbing poliution from auto emissions?

A. limit the number of vehicles one family can own
B. develop and use mass transit systems
C. reduce the size of the auto engine
D. limit fuel consumption

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47. The best method of conserving our energy supply would be:

    A. greater governmental controls
    B. limit the development of energy sources
    C. individual voluntary action of each person
    D. limit the consumption per family in the United States

48. Which of the following has been the greatest impact on society due to the development of power driving the past 50 years?

    A. has made our society more mobile
    B. has made the family a stronger unit of our society
    C. has reduced the crime rate in our country
    D. has made the U.S. the military giant of the world

49. The best asset for a career in the field of power would be:

    A. understanding the total system of power
    B. being able to work with all individuals
    C. in-depth knowledge of a particular area of power
    D. have a basic understanding of industry

50. In the future, career opportunities in the power field will be:

    A. limited because of our limited energy supply
    B. unlimited because of our need to develop new power sources and systems
    C. limited because of the governmental requirements necessary to work in the power field
    D. unlimited because any phase of industry can always use an open-minded person willing to work

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S.E.T. PROJECT POWER CURRICULUM ANSWER SHEET

DATE _____ HOUR _____ NAME _____

CLASS _____ STUDENT # _____

INSTRUCTIONS:

Circle or Black out the letter of the correct response; choose only the one best answer. Make no marks on the test. Mark All answers on this sheet.

1. A B C D
2. A B C D
3. A B C D
4. A B C D
5. A B C D
6. A B C D
7. A B C D
8. A B C D
9. A B C D
10. A B C D
11. A B C D
12. A B C D
13. A B C D
14. A B C D
15. A B C D
16. A B C D
17. A B C D
18. A B C D
19. A B C D
20. A B C D
21. A B C D
22. A B C D
23. A B C D
24. A B C D
25. A B C D
26. A B C D
27. A B C D
28. A B C D
29. A B C D
30. A B C D
31. A B C d
32. A B C D
33. A B C D
34. A B C D
35. A B C D
36. A B C D
37. A B C D
38. A B C D
39. A B C D
40. A B C D
41. A B C D
42. A B C D
43. A B C D
44. A B C D
45. A B C D
46. A B C D
47. A B C D
48. A B C D
49. A B C D
50. A B C D

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KEY FOR S.E.T. POWER CURRICULUM PRE TEST

Correct Responses:

1. C 2. D 3. B 4. C 5. A 6. A 7. A 8. B 9. C 10. C

11. D 12. A 13. A 14. C 15. A 16. B 17. D 18. A 19. A 20. C

21. D 22. D 23. D 24. D 25. D 26. A 27. D 28. B 29. A 30. A

31. A 32. B 33. A 34. B 35. C 36. A 37. D 38. C 39. C 40. A

41. C 42. C 43. C 44. A 45. B 46. 47. 48. 49. 50.

NOTE: Questions 46, 47, 48, 49, 50 do not have a single correct answer. These are value questions and answers will vary due to instructor emphasis and student attitude.

The instructor should evaluate each test and record the results for comparison with the overall test results to find possible areas of strengths and weaknesses in the entire class.

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APPENDIX E

S.E.T. PROJECT
POWER CURRICULUM

POST – TEST

POST – TEST ANSWER SHEET
(See page 75)

POST – TEST KEY AND EVALUATION PROCEDURE

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S.E.T. PROJECT POWER CURRICULUM TEST

INSTRUCTIONS: Answer all questions on the answer sheet.

1. Mechanical energy can be converted to electrical energy with the use of a:

   A. generator
   B. battery
   C. solar cell
   D. solenoid

2. Which of the following conversion methods will not create direct electrical current?

   A. solar cell
   B. a chemical battery
   C. a rotating magnet
   D. a thermo-couple

3. Nuclear reactor is to nuclear energy as the battery is to_____energy.

   A. chemical
   B. mechanical
   C. radiant
   D. thermal

4. If you had to design a system to heat your home for the year 2000, what source of energy would probably be most realistic?

   A. mechanical
   B. electrical
   C. radiant
   D. chemical

5. A cam changes:

   A. rotary to reciprocating motion
   B. reciprocating to rotary motion
   C. neither of these
   D. both of these

6. Electrical energy can be converted to mechanical energy with the use of a:

   A. motor
   B. generator
   C. solar cell
   D. battery

7. A gear can be used:

   A. to change direction of rotation
   B. as a slip clutch
   C. as a reciprocating
   D. as an energy converter

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8. The output of most power systems is in the form of:

   A. heat
   B. motion
   C. light
   D. any of these

9. A generator converts_____energy to electrical energy.

   A. mechanical
   B. thermal
   C. linear
   D. chemical

10. The pump is to a hydraulic system as the_____is to an electrical system.

   A. generator
   B. relay
   C. switch
   D. electrical power line

11. Pressure drop in hydraulic and pneumatic lines is caused by:

   A. friction
   B. plastic lines
   C. high atmospheric pressure
   D. pump action

12. A fuel cell converts chemical energy into:

   A. electrical energy
   B. radiant energy
   C. mechanical energy
   D. nuclear energy

13. The "Wankel" engine is:

   A. reciprocating internal combustion engine
   B. an external combustion engine
   C. a rotary engine
   D. a steam engine

14. Which of the following items is the best electrical insulator:

   A. glass
   B. copper
   C. water
   D. aluminum

15. Bearings are used to:

   A. reduce friction
   B. reduce repair frequency
   C. increase efficiency
   D. all of the above.

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16. The electrical energy necessary for the operation of a small gasoline engine is obtained from:

A. the battery
B. the condenser
C. contact points
D. cutting magnetic lines of force

17. Power is defined as:

A. the rate of energy conversion
B. changing energy from natural to potential form
C. turning effort
D. ability to do work

18. Voltage can be measured with a:

A. test light
B. VOM
C. dwell gauge
D. tachometer

19. Power is defined as:

A. the rate of energy conversion
B. changing energy from natural to potential form
C. turning effort
D. ability to do work

20. A clutch is used to:

A. change direction of motion
B. increase torque
C. engage or disengage motion
D. increase efficiency

21. The output of most powers systems is in the form of:

A. heat
B. motion
C. light
D. any of these

22. Which of the basic machines is an example of pliers action?

A. inclined plane
B. wedge
C. screw
D. lever

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23. Which of the following factors determine whether or not electrical shock can be fatal?

A. voltage
B. amount of current
C. resistance of individual
D. all of these

24. The electrical energy necessary for the operation of a small gasoline engine is obtained from

A. the battery
B. the condenser
C. contact points
D. cutting magnetic lines of force

25. Efficiency is a ratio of:

A. input/control
B. control/output
C. output/friction
D. output/input

26. A V-belt will keep its tension better than a flat belt because of:

A. wedge action of belt to pulley
B. more surface contact
C. greater flexibility
D. greater thickness of belt

27. The present day 4 stroke cycle, spark ignition, internal combustion, reciprocating engine converts:

A. mechanical energy to nuclear energy
B. radiant energy to mechanical energy
C. chemical energy to thermal energy
D. thermal energy to mechanical energy

28. A switch is a device to _____ power.

A. control
B. transmitt
C. convert
D. process

29. A fluorescent bulb converts electrical energy into:

A. sound energy
B. thermal energy
C. mechanical energy
D. radiant energy

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30. A multi-meter (VOM) can be used to measure:

A. hydraulic line pressure
B. voltage
C. torque
D. air pressure

31. A valve is to a hydraulic system as a_____ is to an electrical circuit.

A. generator
B. switch
C. transistor
D. coil

32. Gasoline is obtained:

A. directly from the earth
B. by refining crude oil
C. from man-made materials
D. from burning inorganic materials

33. The difference between the output of an A.C. generator and an alternator is:

A. mechanical
B. radiant
C. thermal
D. chemical

34. The saleable measurement for electricity is:

A. kilovolt/hours
B. kiloamper/hours
C. kilowatt/hours
D. kiloohm/hours

35. Which of the following factors determine whether or not electrical shock can be fatal?

A. voltage
B. amount of current
C. resistance of individual
D. all of these

36. A clutch is used to:

A. change direction of motion
B. increase torque
C. engage or disengage motion
D. increase efficiency

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37. A ratio of output/input would be:

A. horsepower
B. torque
C. work
D. efficiency

38. Which of the basic machines is an example of pliers action?

A. inclined plane
B. wedge
C. screw
D. lever

39. The present day 4 stroke cycle, spark ignition, internal combustion, reciprocating engine converts

A. mechanical energy to nuclear energy
B. radiant energy to mechanical energy
C. chemical energy to thermal energy
D. thermal energy to mechanical energy

40. Which is not an example of a resistor?

A. switch
B. fuse
C. transistor
D. rheostat

41. Electrical power lines and pneumatic lines are similar in that they:

A. are made of metal
B. carry a liquid
C. transmit power
D. are used

42. When in an enclosed area, exhaust gases from an internal combustion engine should be:

A. filtered
B. cooled
C. exhausted outside
D. directed back into the engine

43. A turning force is known as?

A. horsepower
B. torque
C. work
D. work per minute

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44. A solar cell converts:

A. radiant energy to electrical energy
B. radiant energy to thermal energy
C. radiant energy to chemical energy
D. thermal energy to chemical energy

45. The term fluidics refers to:

A. only liquids
B. the control of fluids with no moving parts
C. electricity
D. pressure without movement

46. Which of the following methods would be most realistic in curbing pollution from auto emissions:

A. limit the number of vehicles one family can own
B. develop and use mass transit systems
C. reduce the size of the auto engine
D. limit fuel consumption

47. The best method of conserving our energy supply would be:

A. greater governmental controls
B. limit the development of energy sources
C. individual voluntary action of each person
D. limit the consumption per family in the United States

48. Which of the following has been the greatest impact on society due to the development of power during the past 50 years?

A. has made our society more mobile
B. has made the family a stronger unit of our society
C. has reduced the crime rate in our country
D. has made the U.S. the military giant of the world

49. The best asset for a career in the field of power would be:

A. understanding the total system of power
B. being able to work with all individuals
C. in-depth knowledge of a particular area of power
D. have a basic understanding of industry

50. In the future, career opportunities in the power field will be:

A. limited because of our limited energy supply
B. unlimited because of our need to develop new power sources and systems
C. limited because of the governmental requirements necessary to work in the power field
D. unlimited because any phase of industry can always use an open-minded person willing to work

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KEY FOR S.E.T. POWER CURRICULUM POST TEST

Correct Responses:

1. A	2. C	3. A	4. C	5. A	6. A	7. A	8. D	9. D	10. A
11. A	12. A	13. C	14. A	15. D	16. D	17. A	18. B	19. A	20. C
21. A	22. B	23. A	24. C	25. A	26. C	27. C	28. A	29. D	30. B
31. B	32. B	33. B	34. C	35. D	36. C	37. D	38. D	39. D	40. A
41. C	42. C	43. B	44. A	45. B	46.	47.	48.	49.	50.

NOTE: Questions 46, 47, 48, 49, and 50 do not have a single correct answer. These are value questions and answers will vary due to instructor emphasis and student attitude.

The instructor should evaluate each test and record the results for comparison with the pre-test. The instructor should examine the comparison and possibly make changes in the course for next semester.

The performance objective of the cognitive domain indicates a 20% gain in class mean score between pre-test and post-test scores. You may wish to check your class to see if they reached the performance objective in the cognitive domain.

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APPENDIX F

EQUIPMENT LISTS

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EQUIPMENT NEEDED FOR COURSE

25 Students

QUANITY	EQUIPMENT	SOURCE
2	Power Experimenters	McKnight-McKnight Bloomington, Illinois
2	Model 1000 Concepts of Electricity	Electronic Aids Baltimore, Maryland
1	S1000CK Concepts of Electricity	Electronic Aids Baltimore, Maryland
1	Dynamometer & Air Fuel Measure with Rotary, Diesel, 2 cycle, 4 cycle Engines	Tech Systems,Vega, (Brodhead-Garrett) Go Power (Buck Engineering)
1	Basic set of Power Mechanics tools (wrenches, screwdrivers etc.)	Local Hardware or Supply Co.

Access to materials/process equipment will be needed for the synthesis problem.

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Student Lab Manuals for The McKnight Power Experimenter:

MECHANICAL CONTROL, McKnight & McKnight, Bloomington, Illinois.

FLUID CONTROL, McKnight & McKnight, Bloomington, Illinois.

ELECTRICAL CONTROL, McKnight & McKnight, Bloomington, Illinois.

POWER SYSTEMS– OPTIONAL EXPERIMENTS–POWER PROBLEMS, McKnight & McKnight, Bloomington, Illinois.

Pages referred to:

52-26 to 52-30

E7-205 to E7-210

M1-45 to M1-51

M3-56 to M3-60

05-310 to 05-312

03-300 to 03-303

01-292 to 01-295

F3-123 to F3-127

F2-118 to F2-12

F5-133 to F5-136

F4-128 to F4-132

C3-259 to C3-262

C9-282 to C9-285

F1-113 to F1-117

E6-198 to E6-204

E10-223 to E10-227

E4-187 to E4-190

E2-176 to E2-181

011-333 to 011-336

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